Common Mill Calibration Problems: How To Avoid Them On Your Farm

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INTRODUCTION

Despite the fact that feed accounts for 50 to 70% of the cost of producing a pig it is still an often overlooked management area. Many producers spend less time thinking about their feed than they do about disease, genetics, markets or facilities. Small differences, however, in the quality of feed that pigs receive and the manner in which they are fed can have major effects on the producer's pocketbook.

The most important factor determining feed cost per pig is feed conversion (Table 1). Assuming a cost of $200/Tonne for pig feed, then each 0.1 unit of feed conversion will cost an additional $1.50 per pig. Obviously attention to feed management and the other factors affecting days to market and feed conversion will have a large effect on feed cost and thus profitability of the swine operation.

Table 1. How feed efficiency affects feed cost ($/pig) at different feed prices.

Price of Feed, Dollar Per Tonne

Feed								
Efficiency	$160	$180	$190	$200	$210	$220	$240	$260
3.5	44.80	50.40	53.20	56.00	58.80	61.60	67.20	72.80
3.3	42.24	47.52	50.16	52.80	55.44	58.08	63.36	68.64
3.1	39.68	44.64	47.12	49.60	52.08	54.56	59.52	64.48
3.0	38.40	43.20	45.60	48.00	50.40	52.80	57.60	62.40
2.9	37.12	41.76	44.08	46.40	48.72	51.04	55.68	60.32
2.7	34.56	38.88	41.04	43.20	45.36	47.52	51.84	56.16
2.5	32.00	36.00	38.00	40.00	42.00	44.00	48.00	52.00

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PROBLEMS WITH FEED MILL CALIBRATION

A recent survey in Illinois (Table 2) showed that pig producers were not producing the rations that they thought they were. The analyzed amount of protein in the rations was consistently less than the farmers expected. The reason was incorrect feed mill calibration.

Table 2. Expected vs. analyzed composition of pig feeds.

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Feed	Expected	Analyzed
Starter	18	14.8
Grower	16	14.3
Finisher	14	12.4
Gestation	14	12.4

(Frank et al., 1984; University of Illinois)

Another survey in Manitoba tested the calibration of feed mills on a number of pig farms. They found that 13 out of 18 farm feed mills were out of calibration by more than plus or minus 5%. They also found (Table 3) that error in calibration for protein supplement ranged from 40 to 150% compared to the rate that the producer thought he was using. The error in calibration rates for grain and premix (55 to 175%) was also large.

Table 3. Mill calibration rates compared to recommendations.

	% of Recommendation		
	Number of Farms	Average	Range
Protein supplement	16	87	40-150
Premix	24	107	55-175

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CALIBRATING YOUR METER-TYPE FEED MILL

On-farm meter-type feed mills are often not properly calibrated. This means that you are not mixing the feed in the proportions that you think you are!

Analyses of protein and premix levels in pig feeds usually show that many producers are not making their feed properly. The feed analysis survey in Manitoba tested the calibration of on-farm feed mills and found that 72% were out of calibration for one or more ingredients. Only 50% of the samples were within 10 percentage units of the desired protein content.

The most common reason for incorrect calibration is that the bulk density (bushel weight) and/or moisture levels of the grain and protein supplements are different from that for which the mill was originally calibrated. Bushel weight and moisture levels of grain can be quite variable from load to load, from bin to bin and field to field. Feed mills must be therefore calibrated regularly. The mill should be re-calibrated if density or moisture change more than 3%.

Meter-type feed mills can be calibrated by 2 different methods. The Timed Method or the Simultaneous Method. The Timed Method is the easiest. With this method the flow rate of each ingredient is measured over an equal time period. For example, if the diet should contain 80% corn and 20% supplement the mill should be metering 80 kg (or lbs) of corn in the same time period as 20 kg (or lbs) of supplement. If the ratio of the weights collected is not 80:20 (or whatever it should be for your ration) you adjust the metering controls and try again until you get the right ratio of weights.

The Simultaneous Method involves collecting all the ingredients at the same time into different containers. The total weight and percent or ratio of each ingredient is then calculated. The settings are then adjusted and the ingredients are collected again until the correct ratios or percentages are delivered. The smallest ingredient should have at least 1 kg delivered during the period to make sure you have an accurate measurement.

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SAVE TIME AND MONEY WITH REGULAR MAINTENANCE

Regular maintenance is a must if you expect to produce a top quality feed consistently. So, dig out the owner's manual that came with your mill and find out what procedures you should be following. Why wait for an untimely breakdown to interrupt an already busy day; keep an eye out for problem areas while the mill is operating and fix them promptly. What have you got to lose? If you let something go too long, it may cost you more in lost time, improperly mixed feed and repair costs.

Develop a routine maintenance schedule based on the requirements of your system and stick to it. Think in terms of what you can do on a daily, weekly or monthly basis and as volume milestones (like 100 tons of feed mixed) are reached. For example, whenever you are mixing feed, watch for misaligned belts, signs of equipment being overloaded, and evidence of changes in the feed (like whole kernels).

On a weekly basis, take the time to look for oil leaks, check for wearing and proper tension on belts and chain drives, and for proper lubrication levels. Clean dust and debris away from the electrical control panels, as well as gear boxes and motors, where dust can act as an insulator and cause overheating. Once a month, use a vacuum cleaner to do a thorough cleaning of the entire feed system, including the inside of the mill, mixer, metering and handling equipment. This is also a good time to check for bridging of old feed in feeders, bulk tanks and other equipment, and for cleaning out feeders or checking for feed wastage.

Most importantly, keep a record of any maintenance that you have done, to help you better anticipate when you will need replacement parts.

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DIET PARTICLE SIZE AFFECTS PIG PERFORMANCE

Although on-farm grinding of feed ingredients is common, very few producers know that there is an optimum particle size for the feeds they are grinding. Grinding grains to a larger particle size than necessary slows digestion in the pig's gut, reduces feed intake and decreases feed efficiency by 5 to 8%. On the other hand, too small a particle size increases the potential for gastric ulcers, dustiness, and energy costs of grinding. Feed ground to the optimum particle size will make more profit.

What is the "optimum" particle size? or How fine should I grind?

Particle size is usually described as fine, medium or coarse, but what do these terms really mean? Not surprisingly, depending on who you talk to, the definition can change a lot. Particle size is best described in microns - measurement of the diameter of the individual particles in the feed.

Current research suggests that the optimum particle size for growing pigs (25 to 60 kg) is 700-800 microns (0.7-0.8 mm). Approximate feed/gain ratios for corn diets ground to different particle sizes are shown in Table 4.

Table 4. Effect of particle size of corn on feed efficiency.

Particle Size, microns	less than 700	700 to 1000	more than 1000
Feed/gain ratio	1.75	1.8	2.0

Surveys have shown that the majority of samples analyzed have particle sizes well above the desired range. Since 1985, 70% of samples analyzed at Kansas State

University have been over 800 microns. A similar study in Ontario showed that the average particle size of feed mixed on-farm was around 1000 microns. This means that Ontario farmers are losing out on feed conversion! More farmers should be testing for particle size.

What is the "correct" screen size to use to get the optimum particle size?

The answer to this question is not straightforward. Many factors affect particle size:

Grain type - due to kernel size, hardness, shape and moisture content
- wheat and corn require a larger screen than barley or oats
Flow rate
Grinder/roller speed
Condition and maintenance of the grinder/roller
Screen size, age and condition (PROBABLY THE MOST IMPORTANT FACTOR)

If there is a hole in your screen or your hammers/rollers are worn, you might notice whole, or even half, kernels in the feed. If that is the case, the feed is probably not ground fine enough and you may be losing 3 to 8% in feed efficiency. Obviously, some maintenance is needed and it would quickly pay back your time and money. Table 5 gives the size of corn particles produced by different screen sizes.

Table 5. Particle size produced by hammer mill screens of different sizes.

Screen size 1/16 3/32 3/16 1/4 ½
Particle size 460 580 760 820 1360

This is only a guideline and is based on new screens. Old or worn screens will produce larger particles. For example, a worn 3/16 screen can produce corn with a mean particle size larger that a new 1/4 inch screen.

The best way to determine the screen size to use is to have samples analyzed for particle size. Check with your feed company and see if they offer a testing service. Particle size should be checked every 500 to 700 tonnes of feed processed.

Beware of feed that is too fine. Feed that is finer than 700 microns will produce ulcers in pigs very quickly. At the University of Guelph we found that feed of 550 microns produced ulcers in 90 % of pigs in only 2 weeks and after 4 weeks the first pig died from bleeding ulcers.

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BATCH FEED MIXERS

Many large farms are moving to batch feed mixers. Batch mixers can usually mix more feed, more accurately in less time with lower operating costs. Because feed is weighed into the mixer, rather than measured by volume as in meter-type mills, feed can be made more accurately. BUT improper mixing can still occur.

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COMMON MIXING PROBLEMS IN VERTICAL AND HORIZONTAL FEED MIXERS

Under-filling of any mixer prevents proper mixing. Horizontal batch mixes should be filled to at least one-third while vertical mixers should contain at least 50% of the mixer's capacity.

Overfilling also reduces mixing action. This may be one of the most common problems. With vertical mixers never fill above the top of the elevator and with horizontal mixers you should just be able to see the top edge of the ribbons or

screws above the feed.

The order of loading ingredients into the mixer is critical for proper mixing. For vertical mixers, micro-ingredients or premixes should be added midway through the loading process to make sure they are completely flushed into the mixer and to prevent separation. Horizontal mixers should be loaded first with major ingredients, then with supplements, minerals or premixes. Liquids should only be added, in either mixer type, after the dry materials have been mixed because liquids change the flow pattern and can stop the mixing action altogether.
Mixer speed should always follow the manufacturer's recommendations. Each mixer design has an optimal speed for best mixing action. Running the mixer slower or faster can result in poorly mixed feed and thus poorer pig performance, inefficient use of energy and more maintenance problems.

Build-up in the equipment or carryover into the next batch must be avoided. Fines, sticky feeds or liquids increase build-up and carryover. Remove build-up as soon as possible, flush after additive or antibiotic use, follow recommended feed sequencing and clean by hand as required.

Check regularly for wear. If the clearance between the screws or mixer paddles and the mixer wall is greater than 1/4 to 3/8 inch then ingredients will begin to separate along the walls. Some equipment allows clearance adjustments to be made. If the clearance is too great for further adjustment then the screws or paddles can often be built up.

Test required mixing time when the mixer is new, using the manufacturer's instructions. Then re-test every 3 to 4 months to ensure that it is working properly.

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HOW TO SAMPLE AND TEST YOUR FEED PREPARATION

Feed sampling can be a significant source of error in feed analysis. Table 6 shows the nutrient analysis of 16% pig grower sampled at either the unloading auger, the top of the bin or the middle of the bin. Each sample gave quite different results and leaves one wondering which sample, if any, to believe.

Table 6. Effect of sampling site on nutrient analysis.

	Auger	Top	Middle
Protein, %	14.2	11.9	19.7
Calcium, %	.57	.24	.93
Phosphorous, %	.56	.40	1.05
Salt, %	.40	.19	.46

Table 7 shows the analysis of feed sampled from the auger while a hopper bottom bin was emptied. Again, there were differences but not as great as when the feed was sampled directly from the bin. The conclusion is that care must be taken in sampling to ensure that the sample accurately reflects the entire feed mix.

Table 7. Analysis at 3 different times as feed was emptied from a hopper bottom bin.

	Beginning	Middle	End
Protein, %	17.6	17.4	15.7
Calcium, %	1.09	.99	.74
Phosphorous, %	.95	.85	.65
Fibre, %	3.80	4.20	9.00
Iron, ppm	310	200	200
Zinc, ppm	260	140	140

(Patience, 1981)

What is the proper way to sample feed for nutrient analyses?

The following method of sampling should give a feed analysis representative of the entire mix.
1. Collect feed at 10 different times either while it is being made or while it is being transferred to a bin.
2. Collect 2% to 5% of the total mix but not less than 50 kg.
3. Mix the total collected amount. The best way to mix is with a shovel either on a concrete floor, on a tarp or in a large wheelbarrow or feed cart.
4. Divide the pile in half and mix one of the halves again.
5. Repeat #4 until the amount of feed left is the amount you want to send for analysis.

How to sample for mixing in a batch mixer.

Batch mixers may not mix feed well, whether due to design, wear or improper operation, therefore it is important to test your mixer, under normal operating conditions, to determine how long it takes to achieve a uniform blend.

To test a batch mixer on your farm:

1. Determine the expected concentration of a tracer, such as salt, in the feed.
2. Start mixing, taking samples at specific intervals (for example 4, 8, 12, and 16 minutes after beginning to mix).
3. Take at least 10 samples at each time interval during the mixing and keep them in well-labelled, separate bags.
4. Have the samples analyzed for salt concentration.
5. Determine the mean (average) of the ten samples, the standard deviation (difference from the average) between them and then calculate the coefficient of variation (CV) - standard deviation divided by mean and multiplied by 100. An inexpensive calculator with statistical functions will do these calculations for you.

A CV of less than 10% indicates the samples all came out close to the same and you have achieved a uniform blend. When the CV is greater than 10%, there is a lot of variation between samples and you have a poor mix.

Once you have established a suitable mixing time, continue to test periodically to make sure your mixer continues to perform as expected.

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CONCLUSION

Poor feed preparation will lead to extra days to market, poor feed conversion and increase the cost of feeding a pig. To get the most from your on-farm feed mixing:

1. Check the calibration of your feed mill once per month and your batch mixer every 3 months. If you are unsure how to do this contact the equipment manufacturer or your feed company representative.

2. Recalibrate the mill according to manufacturer's directions if:
a) feed source changes;

b) bulk density (bushel weight) changes more than 5%;
c) moisture changes more than 3%.

3. Analyze your ingredients and diets regularly using a proper sampling method.

4. Know the nutrient requirements of pigs or ask an expert (your Feed Representative or OMAFRA Swine Advisor) for help in ration formulation and feeding program.

5. Keep records on feed usage and feed conversion to identify problems. A sudden or gradual increase in feed usage could mean a problem in the making.

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